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ABSTRACT

Recent developments in media and communication technologies are set to revolutionize the provision of education and training. With modern technology, it is possible to deliver lectures, assignments, tutorials, simulations, and even the contents of the world's best libraries to anyone in possession of a modem and computer. Diminishing funding and overt competition have fostered the development of teaching and learning methods that can reach a wider market and that do not involve expensive commodities such as lecturers or classrooms. This paper looks at the growth of the Internet and development of the educational superhighway and how it will affect the future of traditional higher education. The paper discusses the ability of the educational superhighway to provide "on-demand" service; changes to universities because of the elimination of time and space barriers; choices of modules from different universities all over the world; administration of the virtual university; automated assessment techniques; and changes to the role of the lecturer. The Internet has the potential to revolutionize education and training. There is still a long way to go in building the education superhighway--there are many people throughout the world without telephones, let alone Internet connections. The infrastructure is developing that will provide high-speed affordable access to schools, colleges, and communities. (Contains 14 references.) (Author/SWC)

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The future of online education and training

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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Abstract: *The climate of higher education has changed radically in recent years. There is now an undisguised attitude of competition between universities that sits uneasily alongside the traditional collegiate spirit. Diminishing funding and overt competition have fostered the development of teaching and learning methods that can reach a wider market and that do not involve expensive commodities such as lecturers or classrooms. Moreover, students' expectations are more than ever shaped by a prevailing culture of 'on-demand' resources, unconstrained by time or geography. But are the economic arguments really that clear cut? Is it educationally sound, cost-effective and reliable? Surely we should first identify the pedagogic principles associated with this new medium, and consider how teachers can most effectively provide an interactive, supportive and critical learning environment.*

Keywords: Online education, training, schools, colleges, virtual university

1. Introduction

Recent developments in media and communication technologies are set to revolutionise the provision of education and training. With modern technology it will soon be possible to deliver lectures, assignments, tutorials, simulations, even the contents of the world's best libraries to anyone in possession of a modem and computer. Furthermore, amongst all these concrete benefits comes another that may be less tangible but is equally important: the shift towards a more student-centred approach. Learners are now freed from the barriers of time and space imposed by conventional classroom teaching, and encouraged to interact with the material in ways that could never be supported adequately by traditional teaching methods.

According to many observers, we are now witnessing the advent of the 'virtual university'. Furthermore, as the virtual university expands, it will ultimately lead to the demise of the traditional campus-based university.

But is this extreme scenario really likely to happen, or is it just another case of media hype fuelled by a few reactionary technophiles? The 'Education Superhighway' is certainly the subject of considerable media attention at present. Indeed, the current expansion of the Internet has been described by some as similar to a gold rush (Abbot 1996), leading to periods of frantic activity as companies and colleges register domain names and set up Web sites.

Amongst all this hysteria there are many serious questions that remain unanswered. For example:

- what are the pedagogic principles associated with this new medium?
- is it educationally sound, cost-effective and reliable?
- what skills do learners initially require, and what skills and qualities will the virtual universities help them to develop?
- how can the teachers most effectively provide an interactive, supportive and critical learning environment?

Without adequate attention to these issues we may find that the real future of online education and training becomes one of information overload, random browsing and solitary confinement.

2. The present situation

2.1. The growth of the Internet

In order to place the claims made about the information superhighway in proper perspective it is useful to start by outlining the present situation.

It is estimated that there are presently around 7 million computers connected to the Internet. By comparison, there are around 660 million telephones in use. Clearly the Internet has a long way to go. But with 80% annual growth, compared to 6-7% for the telephone system, the Internet should catch up by the end of the decade. North America still has the lead, with an estimated 17% of the population of US and Canada having Internet

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access by January 1996. Interestingly, they spend as much time surfing the Net as watching videos they have recorded (Abbot 1996). Current estimates of the numbers of users on the Internet vary wildly (anything between 30 and 60 million), but it is predicted that there will be as many as 125 million by the end of 1997 (NCET 1995).

Recent research shows that 20% of UK households currently have a computer, and this number is growing rapidly. By the end of 1996 half of these will have a network connection (DTI 1996). It is estimated that by the end of 1995, around 2000 UK schools were connected to the Internet (HMSO 1995). When compared to developments in the US, this figure sounds somewhat modest. But much of this discrepancy can be attributed to the availability of free local telephone calls in the US, and relatively high set-up costs and tariff levels in the UK (HMSO 1995).

2.2. The development of the educational superhighway

The development of the information superhighway has been precipitated by a convergence of three key industries: telecommunications, broadcasting and IT. Fibre optic cable is gradually replacing copper wire and offers the potential to deliver a wide variety of services, including education. An example of such a network is SuperJANET, which is the world's first educational superhighway. SuperJANET includes a 34Mbit/s data network interconnecting 60 sites across the UK, allowing group working, advanced information services, remote consultation and distance learning (HMSO 1995).

Evidently, the first step on the road to building a credible education superhighway has been the development of the Internet, and particularly the World Wide Web. The next step will be the development of higher bandwidth networks. Investment by cable TV companies will provide broadband network connections to homes and schools in urban areas in the near future. But the education superhighway is not solely concerned with the Internet or the forthcoming broadband networks. Other technologies that will remain an integral part include:

- *CD-ROM*: this will continue to be an essential distribution mechanism for many multimedia applications (networked or otherwise);
- *interactive video*: this technology most closely resembles the type of applications that may become available over the education superhighways;
- *satellite communications*: this will help mobile users and those in remote locations. Reception equipment will enable schools and colleges to receive broadcast material, and when combined with transmission equipment, video conferencing becomes possible;
- *microwave and radio technology*: this will facilitate 10Mbps data transfer and improve access in rural areas.

3. So what does the future hold?

The current wave of euphoria (and investment) surrounding the education superhighway would certainly suggest that its arrival is imminent. The logic would appear to be simple: if high quality, properly designed learning materials can be downloaded to anyone in possession of a modem and computer then it would appear that the days of the traditional university (at least, in its present guise) are truly numbered.

3.1. An 'on-demand' service

The simplest and most profound effect will be the elimination of constraints on time and space. Learning materials can be downloaded at any time, to any place. Indeed, the trend toward this type of service is reflected by similar developments in the home entertainment business (such as video-on-demand). Part of this development will be a change in emphasis as learning becomes a more student-centred process. Instead of the learning process revolving around the university, the student will become the focus of the experience (Hutchison 1996).

It is likely also that the student body will expand and diversify, as easy access to the Internet will enable more sectors of the community to engage in learning programmes. These will replace some of the more traditional TV-based programmes, and the capacity for interaction will facilitate a range of learning styles. Furthermore, since the student is in control of the pace of learning, the virtual university may more easily accommodate variations in student ability.

3.2. Changes to the universities

With restrictions on time and space lifted, the virtual university can take greater numbers of students, almost without limit. So what need now is there for so many classrooms and tutors' offices? Perhaps expensive commodities such as these will be the first to be sacrificed to fund the new investment. Universities that are slow to change may find themselves becoming merely nodes on the network, providing laboratory facilities that are accessible via remote links. Alternatively, they could adapt to become centres of research and postgraduate training.

3.3. Choice of modules

The virtual university will inevitably increase student choice, since individuals can now select modules from more than one provider. Why take all your modules from Anytown College when you can download a combination from Oxford, MIT and the Sorbonne? However, such combinations are not totally without constraint: some regulation will still be required in order to be eligible for a recognised qualification.

As universities race each other to provide learning materials for this expanding market, they will inevitably experience a considerable lead time in converting their conventional materials to online programmes. They may then find their interests (and perhaps also their finances) best served by acting as 'learning agencies', presenting materials developed by other organisations alongside their own. Course material from a range of providers can then be channelled into a cohesive programme with a recognised degree title.

But wherever there is selling, there is competition. Will the inevitable market forces lead to excellence, or simply cost-cutting by the providers? Moreover, what financial model is appropriate for such services? Should we be paying for the course, the module, or on a pounds-per-page basis? Since the learning is on-demand, like electricity from a socket, perhaps the payment method should follow suit (i.e. pounds per unit consumed). Other models, e.g. payment by the hour, may encourage learners to cut corners when under financial pressure. Evidently, finding the right approach requires detailed consideration of the political issues as well as the technical and pedagogic.

3.4. Administration

The education superhighway will bring several benefits in the administration of student progress. It becomes possible to monitor students' learning behaviour, logging their activity, recording their choices and interactions. With online submission of course material, hand-in rates can be monitored and warnings issued when individuals are persistently late. Moreover, now that the course material is essentially a single electronic copy, it is much more easily updated than the traditional collection of papers, OHTs and textbooks.

3.5. Automated assessment

Online education enables a variety of automated assessment techniques to become viable. The technology for marking multiple choice tests already exists, and marking schemes can be devised that allow a surprising degree of sophistication. Furthermore, it is even possible to automate the exam-setting process itself. Webmark (Attree 1996) is a CGI Perl application that will create a Perl script to set and mark a multiple choice questionnaire. Students can then remotely sit the test, and the results can be fed back to the student and/or tutor.

But not every academic subject is adequately assessed using multiple choice questionnaires. For some, the essay remains the primary vehicle of expression. However, the day when essays can be marked remotely by machine remains (perhaps thankfully) somewhat distant.

In between the multiple choice question and the complete essay there remains a spectrum of further interactions with potential for automated assessment. For example, students on programming courses typically have to produce examples of their own program code. This too can be subject to online assessment, using both static and dynamic metrics. Indeed, the evidence suggests that students actually prefer to be marked by machine rather than by another person (Benford *et al.* 1994).

But what of other types of student, whose output does not usually consist of program code or multiple choice answers? Is there any way to assess their output automatically? Some work is already underway in this area. Allott *et al.* (1995) have devised an automated marking system that makes a binary decision of truth or falsehood of single sentence exam questions using an activation passing network (APN). Preliminary trials using this system show great promise. However, a major problem with this approach is that the knowledge in the APN has to be hand-coded. Consequently, current research effort is directed toward automating this process by extracting relevant knowledge direct from textual sources (Bowden *et al.* 1996).

Another intriguing possibility is the use of virtual reality as a vehicle for assessment. Whereas written exam papers can demonstrate learners' descriptive understanding of a subject, a VR-based examination could potentially engage their real-time problem-solving ability, involving them as interactive participants in a task that requires specific cognitive skills and abilities.

In addition to the 'technology push' in this direction, there is a political precedent. At the last Labour Party Conference, Tony Blair promised to connect every school and library (permanently) in return for securing BT's future. In addition, every child will have access to a laptop. However, those children for whom the laptop is an everyday tool will not wish relinquish it easily at the examination door. After all, calculators are now accepted as an essential item of equipment for certain subjects: why not computers?

3.6. Changes to the lecturer's role

In schools, the role of the teachers will broaden to include less authoritarian practices. Consequently, the dividing line between them and the learners will become progressively more blurred as teachers and learners become 'fellow browsers in the cybernetic library' (Pickering 1996).

Similarly, the role of lecturers in higher education is also set to change. The research element may continue as before, perhaps benefiting from improved external links and electronic libraries. But with no classrooms, what new teaching skills will be required? One possible outcome is that lecturers will become courseware designers, developing the multimedia authoring skills necessary to create their own materials. Tutoring can still be done,

albeit remotely. Acting like freelance agents, tutors can be hired on an 'as-needed' basis. Such an arrangement is already commonplace for many Open University tutors (indeed, the OU has pioneered many developments in this area, such as virtual summer schools and 'paperless' courses provided over the Internet). This pattern of working is reflected in society at large, with increasing casualisation of labour and a shift toward contract-based, part-time employment.

4. Some cautionary thoughts

One of the major problems facing the development of a credible education superhighway is the lack of a suitable financial model. It is not clear how best to combine the (possibly conflicting) goals of student choice, quality and return on investment for the provider. Without careful planning, the tendency from both sides (learner and provider) will be to cut corners and costs. A related problem that is particularly acute for students of the virtual university is that since so much material is now held in digital form, the potential for copyright infringement (and its consequent effect on royalty payments) becomes so much greater. The ease with which individuals can cut and paste networked material presents a considerable challenge to a human assessor, and invites a reappraisal of the boundary between plagiarism and legitimate research.

Perhaps the very concept of 'ownership' needs to be reconsidered, now that material can so easily be acquired, processed and re-arranged. On a more pragmatic note, it is possible that our perception of what constitutes an 'original' piece of student work needs to change. Instead of requiring a wholly self-penned exposition, perhaps we should welcome a collection of original and derivative material, on the understanding that its combination represents the student's view of an effective criticism of the subject.

There remains the problem of the 'dark' side of the Internet: viruses and pornography. The latter problem is particularly acute for schools and a number of countermeasures are currently being investigated. One solution is to use an access provider that monitors its own content, e.g. BT's CampusWorld. Full Internet access is allowed but users are encouraged to use the 'walled garden' — a safe subsection of the Internet that focuses on educational material and support. Another approach adopted by some access providers is to exercise a kind of censorship by blocking access to certain Web sites that are deemed 'unsuitable'.

As ever with IT investment, developing an overall strategy remains problematic — how can long-term plans be made when the technology changes so rapidly? Much of the equipment present in UK schools is greater than five years old, and even with expenditure on IT hardware at around £150 million pounds it cannot keep up with the pace of current developments (DTI 1996). But plan they must, since parents have invested massively in educational technology in the past two to three years, in the expectation that their children's learning will benefit. If schools' IT plans do not do reflect this, their annual pleas of institutional poverty will not be received sympathetically (Heppell 1996).

Costs remain a major barrier. A connection to JANET or SuperJANET may be possible for schools sponsored by a higher education institution, at around £100 p.a. for dial-up access and £1000 p.a. for affiliate status. In particular, schools need flexible tariff structures that avoid the open-ended costs usually associated with dial-up charges.

In addition to the hardware costs there are the staff costs. Sophisticated IT skills are required to administer e-mail accounts, newsfeeds, local information servers and network connections. However, in 1993/4 up to 50% of secondary schools and 30% of primary schools had received only initial awareness training or none at all (DTI 1996). Moreover, a significant percentage of schools do not have LANs in their computer labs (Parker 1994).

5. Conclusions

When Gutenberg invented the printing press it helped generate an information explosion that precipitated the Renaissance and in turn led to the establishment of modern science (Foremski 1994). Will the second information revolution have effects of similar magnitude?

There is no doubt that the Internet, even in its present form, has the potential to revolutionise education and training. It already contains much information that is of great value, although much of it is incomplete or hard to locate. However, advances in user interfaces and search tools will go some way to alleviating such problems.

Certainly, the Internet has its faults, notably the lack of formal structure and the absence of guarantees for its contents. But a more charitable appraisal would acknowledge the generosity and altruism of the contributors, and view that as the foundation of a global partnership in learning and cultural development.

There is a still long way to go in building the education superhighway. There are many people throughout the world without telephones, let alone Internet connections. We are thus faced with the possibility of a gap between those who benefit from the Internet and those who do not, both within and across cultures (Pickering 1996). However, the first steps have now been taken and the direction looks irreversible. The infrastructure is developing that will provide high-speed affordable access to schools, colleges and communities. What we need now is the political will to provide the educational services that the next generation deserves.

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